
**Rubber, vulcanized or thermoplastic —
Determination of adhesion to metal —
Two-plate method**

*Caoutchouc vulcanisé ou thermoplastique — Détermination de
l'adhérence au métal — Méthode à deux plaques*

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Contents

Page

Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Principle	1
5 Apparatus	2
6 Calibration	4
7 Test piece	4
7.1 Dimensions.....	4
7.2 Preparation.....	4
7.3 Number.....	5
7.4 Conditioning.....	5
8 Procedure	5
9 Expression of results	5
9.1 Adhesion value.....	5
9.2 Adhesion failure symbols.....	5
10 Test report	6
Annex A (normative) Calibration schedule	7

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analysis*.

This sixth edition cancels and replaces the fifth edition (ISO 814:2011), of which it constitutes a minor revision to update the normative references in [Clause 2](#) as well as the failure symbols in [9.2](#).

Rubber, vulcanized or thermoplastic — Determination of adhesion to metal — Two-plate method

WARNING 1 — Persons using this document should be familiar with normal laboratory practice. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

WARNING 2 — Certain procedures specified in this document might involve the use or generation of substances, or the generation of waste, that could constitute a local environmental hazard. Reference should be made to appropriate documentation on safe handling and disposal after use.

1 Scope

This document specifies a method for determining the adhesion strength of rubber-to-metal bonds where the rubber part is assembled between two parallel metal plates, using the adhesive system under investigation.

The method is applicable primarily to test pieces, prepared in the laboratory under standard conditions, such as can be used to provide data for the development of rubber compounds and control of methods of manufacture.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5893, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Specification*

ISO 18899:2013, *Rubber — Guide to the calibration of test equipment*

ISO 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

4 Principle

The test consists in measuring the force required to cause the rupture of a unit of standard dimensions, comprising rubber bonded to two parallel metal plates, the direction of the force being at 90° to the bonded surface.

5 Apparatus

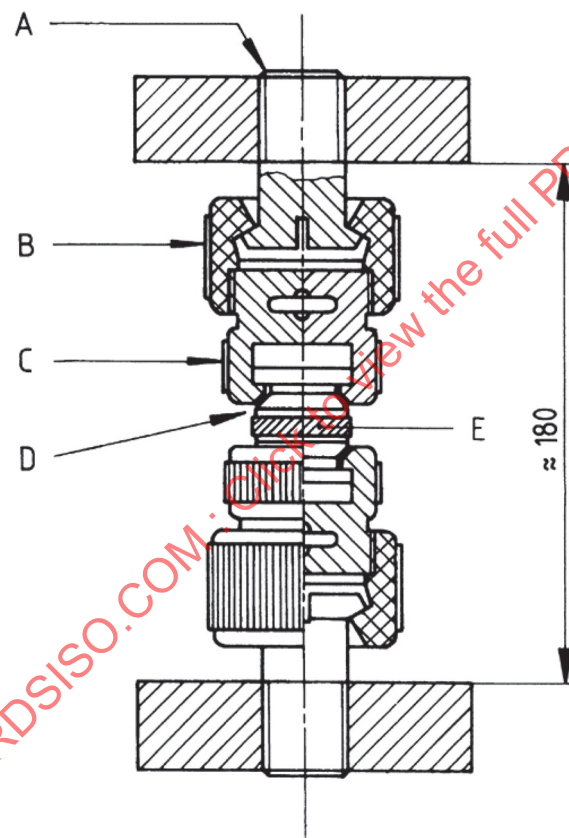
5.1 Tensile-testing machine, complying with the requirements of ISO 5893, capable of measuring force with an accuracy corresponding to class 2 as defined in ISO 5893, and with a rate of traverse of the moving grip of 25 mm/min $\pm$ 5 mm/min.

NOTE Inertia (pendulum) type dynamometers are apt to give results which differ because of frictional and inertial effects. An inertialess (for example, electronic or optical transducer) type dynamometer gives results which are free from these effects and is therefore preferred.

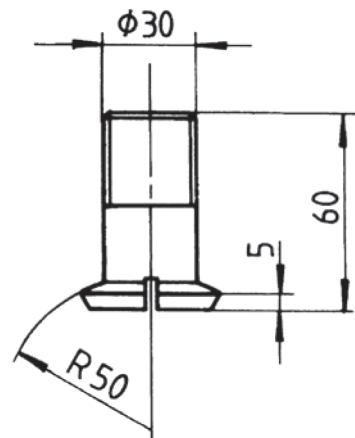
5.2 Fixtures, for holding the test pieces in the test machine (5.1), which permit accurate centring of the applied load during the test.

A suitable type of fixture is shown in [Figure 1](#).

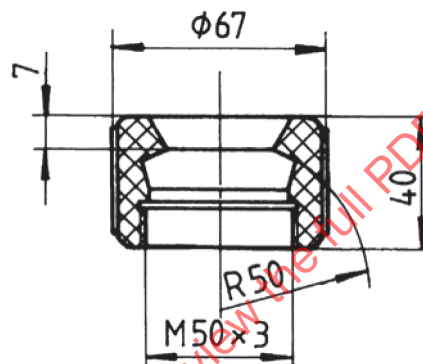
Dimensions in millimetres



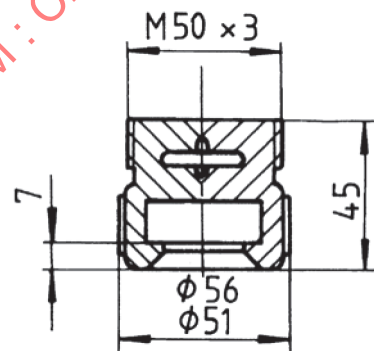
a) Assembly of parts



b) Part A



c) Part B



d) Part C

Key

- A tail fillet to suit test machine
- B bridle fillet threaded to take part C
- C split across centre to accept test piece and threaded to fit into part B
- D metal part of test piece
- E rubber

Figure 1 — Example of test fixture for holding rubber-to-metal bond test pieces

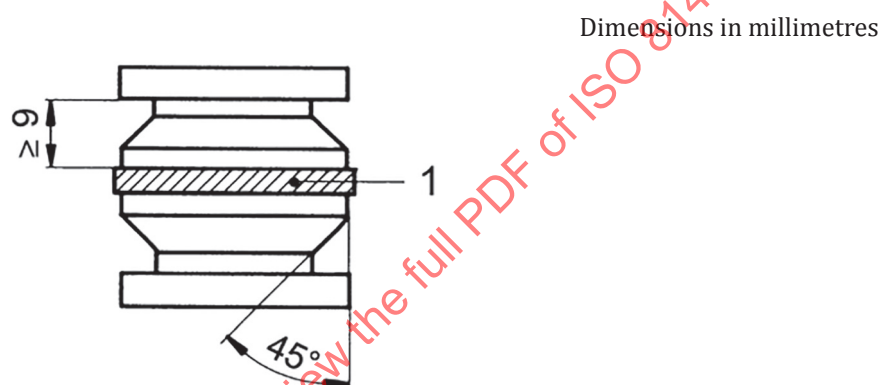
6 Calibration

The test apparatus shall be calibrated in accordance with [Annex A](#).

7 Test piece

7.1 Dimensions

The standard test piece shall consist of a rubber cylinder $3 \text{ mm} \pm 0,1 \text{ mm}$ thick and of diameter between 35 mm and 40 mm known to the nearest 0,1 mm, having its circular ends bonded to the faces of two metal plates of equal diameter, the determination of dimensions of the test piece being in accordance with ISO 23529. The diameter of the metal plates shall be approximately 0,1 mm less than that of the rubber cylinder. The thickness of the metal plates shall be not less than 9 mm. A typical test piece is shown in [Figure 2](#).



Key

1 test piece

Figure 2 — Example of standard test piece

7.2 Preparation

7.2.1 Circular metal plates of the standard dimensions shall be prepared preferably from rolled carbon steel bar. Other metals may be used provided that the parts are in conformity with the essential dimensions. The smooth metal parts shall be prepared and treated in accordance with the adhesion system under investigation.

7.2.2 Rubber discs shall be cut using a circular die of such size that a limited amount of flash is obtained on moulding. The surface of the rubber to be bonded to the metal shall be treated in accordance with the method being investigated.

7.2.3 The rubber discs and metal end pieces shall then be assembled for moulding in the mould. The mould shall be constructed so that the rubber projects beyond the edges of the metal end pieces by approximately 0,05 mm in order to prevent tearing of the rubber by the edge of the metal during testing.

7.2.4 During the preparation of the test piece, great care shall be taken to keep the exposed surfaces of the rubber and metal free from dust, moisture and other foreign matter. The surfaces shall not be touched by hand during assembly.

7.2.5 Moulding shall then be carried out by heating in the mould under pressure for a definite time at a controlled temperature in a suitable press. The time and temperature of moulding shall be in accordance with the system being investigated.

7.2.6 At the conclusion of the cure, great care shall be taken in removing the test pieces from the mould to avoid subjecting the bonded surfaces to undue stress before the test pieces have cooled.

7.3 Number

At least three test pieces shall be tested.

7.4 Conditioning

7.4.1 The test pieces shall be conditioned in accordance with the requirements of ISO 23529 for at least 16 h at a standard laboratory temperature ($23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ or $27\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$) immediately before test, the same temperature being used throughout any one test or series of tests intended to be comparable.

7.4.2 The time-interval between vulcanization and testing shall be in accordance with the requirements of ISO 23529.

8 Procedure

8.1 Mount the test piece in the fixtures (5.2) in the test machine (5.1). Extreme care is necessary in centring and adjusting the test piece so that the tension is uniformly distributed over the cross-section during the test.

8.2 Apply tension by separating the jaws at a constant rate of $25\text{ mm/min} \pm 5\text{ mm/min}$ until the test piece breaks. Record the maximum force.

9 Expression of results

9.1 Adhesion value

The adhesion shall be calculated by dividing the maximum force by the cross-sectional area of the test piece. It shall be expressed in pascals.

9.2 Adhesion failure symbols

Assess the type of failure, using the following symbols:

R	When failure is in the rubber.
RC	When failure is at the interface between the rubber and the layer of adhesive.
CP	When failure is at the interface between the layer of adhesive and the primer (if used).
PS	When failure is at the interface between primer (if used) and the substrate.
CS	When failure is at the interface between the adhesive and the substrate (where no primer used).
D	When failure is at the interface between the rubber and the substrate in the case of direct adhesion, i.e. no adhesive used.
S	When failure is in the substrate.

NOTE It is not always possible to distinguish between RC and CP, and failure in a metal substrate is highly unlikely.

10 Test report

The test report shall include at least the following information:

- a) a reference to this document, i.e. ISO 814;
- b) details of test piece:
 - 1) the time and temperature of vulcanization,
 - 2) the date of vulcanization,
 - 3) the diameter of the rubber part of the test piece,
 - 4) the metal used for the metal plates, if other than the steel specified;
- c) test details:
 - 1) the time and temperature of conditioning prior to test,
 - 2) the temperature of the test,
 - 3) any unusual features noted during the determination,
 - 4) the number of test pieces tested,
 - 5) any operation not included in this document or in the International Standards to which reference is made, as well as any operation regarded as optional;
- d) test results:
 - 1) the test result for each test piece, expressed in accordance with [9.1](#),
 - 2) a description of the type (or types) of failure, expressed in accordance with [9.2](#), indicating the percentage failure of each type which occurs;
- e) the date of the test.

Annex A (normative)

Calibration schedule

A.1 Inspection

Before any calibration is undertaken, the condition of the items to be calibrated shall be ascertained by inspection and recorded in any calibration report or certificate. It shall be reported whether calibration is carried out in the “as-received” condition or after rectification of any abnormality or fault.

It shall be ascertained that the apparatus is generally fit for the intended purpose, including any parameters specified as approximate and for which the apparatus does not therefore need to be formally calibrated. If such parameters are liable to change, then the need for periodic checks shall be written into the detailed calibration procedures.

A.2 Schedule

Verification/calibration of the test apparatus is a mandatory part of this document. However, the frequency of calibration and the procedures used are, unless otherwise stated, at the discretion of the individual laboratory, using ISO 18899 for guidance.

The calibration schedule given in [Table A.1](#) has been compiled by listing all of the parameters specified in the test method, together with the specified requirement. A parameter and requirement can relate to the main test apparatus, to part of that apparatus or to an ancillary apparatus necessary for the test.

For each parameter, a calibration procedure is indicated by reference to ISO 18899, to another publication or to a procedure particular to the test method which is detailed (whenever a calibration procedure which is more specific or detailed than that in ISO 18899 is available, it shall be used in preference).

The verification frequency for each parameter is given by a code-letter. The code-letters used in the calibration schedule are:

- C requirement to be confirmed, but no measurement;
- N initial verification only;
- P particular procedure;
- S standard interval as given in ISO 18899;
- U in use.